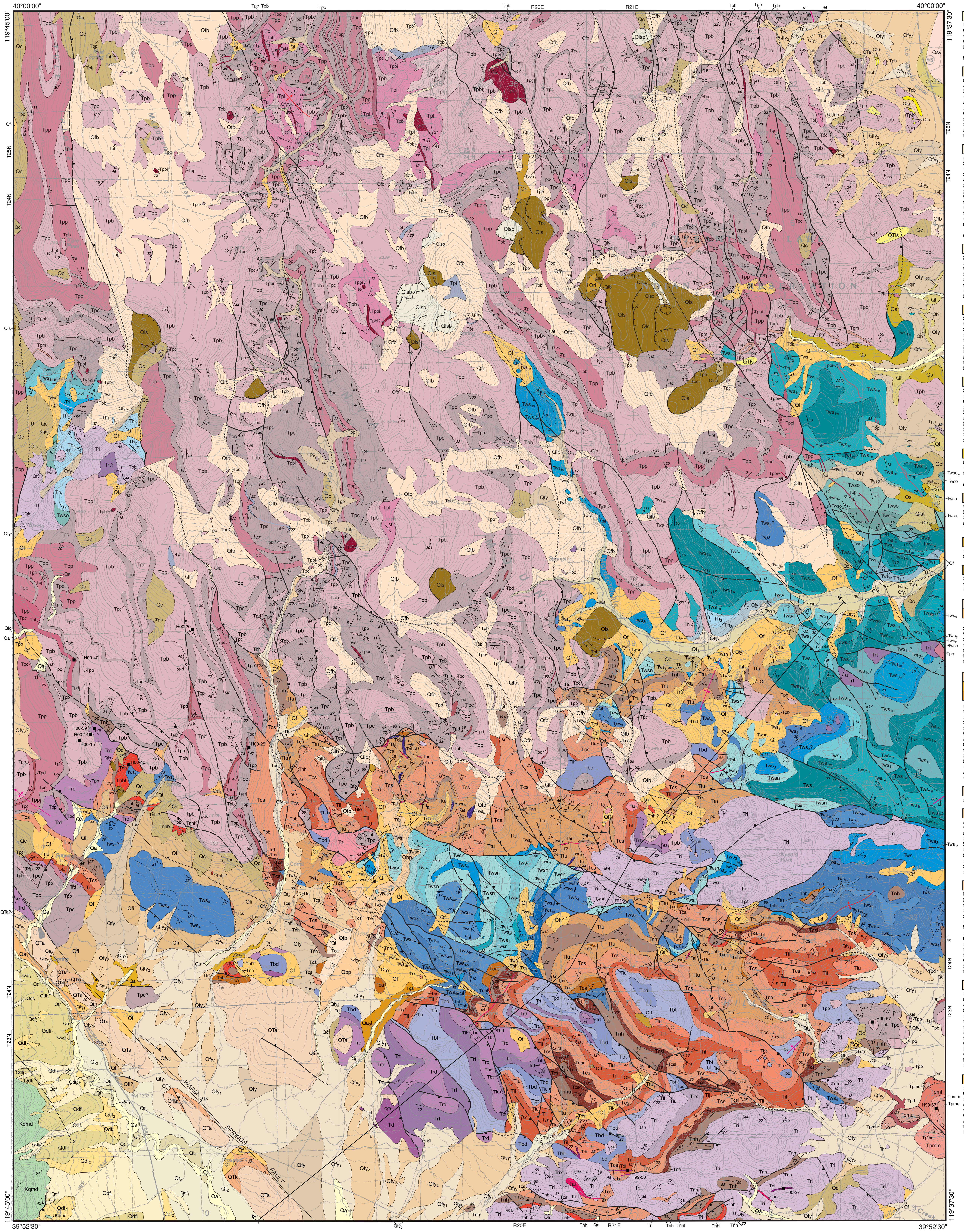

Scale 1:24,000

CONTOUR INTERVAL 10 METERS

Base map: U.S. Geological Survey Tule Peak 7.5' Quadrangle, 1980 Digital Raster Graphic (DRG)

PRELIMINARY GEOLOGIC MAP OF THE TULE PEAK QUADRANGLE, WASHOE COUNTY, NEVADA

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2001

Qa Active alluvium Recently to annually active alluvium consisting of cobble-pebble gravels and sands in washes, locally with boulders in proximal reaches. Clasts are generally subrounded to rounded, but subangular clasts are locally common. The main channel that crosses Winnemucca Ranch Road contains pebbly sands with anastomosing braided bar and swales. These deposits are typically 0.5 to more than 3 m thick.

Stream Channel Deposits of Winnemuccca Valley

Qt_1 Alluvial terrace deposits (mid to late Holocene) Cobbly and pebbly coarse to medium sands, dominantly poorly sorted and matrix supported, but locally clast supported; intercalated with well-sorted, medium-grained sand deposits up to 10 cm thick. Clasts are generally subrounded to rounded, although some subangular clasts exist. Sands and small pebbles are dominantly granitic rocks, whereas larger clasts are dominantly volcanic rocks. Surface is generally smoothed with up to a few centimeters thick, eolian silt cap, but broad, subdued bar and swale topography is also common. Soils are typically either absent or have a weak cambic horizon. However, moderately well developed mollic epipedons characterize meadows and associated spring deposits. Deposits unconformably overly Qt_2 deposits and are typically 60 cm thick.

Qt_2 Alluvial terrace deposits (latest Pleistocene to earliest Holocene) Pebbly coarse sands, fine sands, and white to pale-brown diatomaceous earth. Some pebble gravels and isolated boulders are also present. Bedding is thin, parallel, wavy with some cross-beds; diatomaceous earth is a thick-bedded unit with parallel, cross-bedded, and convolute sedimentary structures and some minor very thin beds intercalated with overlying sands. Clasts are well- to poorly-sorted and subangular to subrounded. Sands are up to 99% granitic, whereas pebbles are dominantly volcanic rocks. Some iron-staining occurs in coarser sands, and incorporated twigs are commonly replaced by hematite. Surface is smooth, relatively flat, and locally moderately dissected. Soils range from cambics and weak argillic B horizons to mollic epipedons, where the surface is wet from springs and meadow environments. Deposits are up to 4 m thick. Diatomaceous earth likely originated from the high stand of Lake Lahontan.

Alluvial Fans of Dogskin Mountain (SW corner of quadrangle)

Qdf_1 Alluvial fan deposits (mid to late Holocene) Cobbly, pebbly, coarse sands with isolated boulders in proximal parts; generally non-indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts that are dominantly granitic in composition. Surfaces commonly have depositional microtopography, including bar and swale topography, and broadly undulating and pocketed surface morphology. Soil development ranges from none to A/Bw/C profiles, where the colored cambic horizon is weakly developed and as much as 20 cm thick. Deposits are up to 3 m thick.

Qdf_2 Alluvial fan deposits (latest Pleistocene to early Holocene) Cobbly, pebbly, silty, coarse sands with some boulders in proximal parts; generally non-indurated to weakly indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts that are dominantly granitic in composition. Surfaces are commonly smoothed with poorly to moderately developed pavements and local relict cobble or boulder gravel bars within which the fines have been winnowed. Soil development ranges from A/Bw/C to A/Bt/Bca/C profiles with colored cambic or weak argillic horizons 20 to 50 cm thick. Calcic horizons (Bca) are nonexistent to weakly developed (up to stage II CO_3 development). Deposits are up to 4 m thick.

Qdfi Alluvial fan of granite (early to mid Pleistocene) Cobbly, pebbly, silty, coarse sands with local boulders in proximal parts; generally weakly to moderately indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts that are dominantly granitic in composition. Surfaces are smoothed to slightly irregular, and are moderately to well dissected. Soils are typically A/Bt/Bca/Cox/C profiles, where argillic horizons (Bt) are well developed, structured, and up to 50 cm thick, calcic horizons (Bca) are intermittent, but with up to stage III CO_3 development, and oxidized, iron-stained horizons (Cox) are up to 2 m thick. Soil profiles are commonly missing the silty, eolian A horizon due to the vertisolic nature of the argillic horizon. Deposits are as much as 4 m thick.

Qbg Megabreccia of granite (early to mid Pleistocene) Non-indurated monolithologic breccia consisting of subrounded to subangular boulders of granite (Kqmd) as much as 4 m in length. Matrix consists of smaller fragments of granite. Qbg probably originated as a rock avalanche deposit. Thickness is as much as 6 m.

Alluvial Deposits of the Virginia Mountains

Qc Undifferentiated Quaternary colluvium and talus Small- to medium-size colluvial and talus slopes generally developed at the base of cliffs or steep slopes of resistant Oligocene welded tuffs (e.g., Tnh) and sequences of Miocene basaltic andesite lavas (Tpb). Stone stripes are typical on talus slopes. Deposits typically consist of angular and subangular cobbles and boulders and are clast supported. Thickness is generally less than 3 m.

Qrf Recent rockfalls Isolated clast-supported masses of angular blocks ranging up to several meters in length and containing little, if any, matrix. In all cases, these deposits occur proximal to nearby cliffs. Thickness is as much as 4 to 5 m.

Qls Landslide deposits Coarse, unconsolidated debris composed of local bedrock, particularly basaltic andesite lava of the Pyramid sequence. Clasts range from silt to large blocks, up to 15 m in diameter. Probably as much as 20 m thick. Original headwall scarp is unrecognizable or nearly so.

Qfy_1, Qa_1 Alluvial fan and stream terrace deposits (mid to late Holocene) Bouldery, cobbly, to pebbly coarse to fine sands. Non-indurated to weakly indurated, moderately stratified, poorly sorted, matrix- and clast-supported deposits with angular to subangular clasts; some clasts are subrounded in distal parts of fans. Clasts are ubiquitously volcanic rocks, mostly felsic and mafic. Surfaces commonly have bar-and-swale topography and include active distributive portions of fans. Soils are typically nonexistent, but some A/C profiles exist where thin (<3-cm thick) eolian silts have been deposited on the surface. Deposits are commonly 0.5 to 1 m thick. **Qfy_1** are alluvial fan deposits. **Qa_1** are alluvial deposits that are commonly stream terraces.

Qfy_2, Qa_2, Qa_2t Alluvial fan and stream terrace deposits (latest Pleistocene to early Holocene) Bouldery, cobbly, to pebbly coarse to fine sands. Non-indurated to weakly indurated, moderately stratified, poorly sorted, matrix- and clast-supported deposits with angular to subangular clasts; some clasts are subrounded in distal parts of fans. Clasts are ubiquitously volcanic rocks. Surfaces are generally smoothed with moderately well- to well-developed interlocking pavements. Clasts on surfaces are commonly iron-stained or covered with moderately developed rock varnish. Soils typically have A/Bw/Bca/C profiles with eolian silt caps (A) up to 10 cm thick, colored cambic (Bw) horizons with some clay up to 30 cm thick, and discontinuous calcic horizons (Bca) with stage I CO_3 development. Deposits are commonly 0.5 to 3 m thick. **Qfy_2** are alluvial fan deposits. **Qa_2** are massive to moderately-stratified, non-indurated to moderately indurated, locally pebbly, medium- to fine-grained-sandy stream terrace deposits. Carbonate cementation occurs in the upper 30 cm of the deposits and includes carbonate laminae up to 3 cm thick. **Qa_2t** sediments are light-gray and light-brown, massive to weakly-stratified, rhyolitic, tuffaceous, cobbly, pebbly, fine-sandy, moderately sorted, stream terrace deposits.

Qfy Undifferentiated alluvial fan deposits (latest Pleistocene to late Holocene) Mixed Qfy_1 and Qfy_2 deposits, commonly a thin veneer of Qfy_1 gravels overlying Qfy_2 deposits.

Qfi Alluvial fan deposits (early to mid Pleistocene) Bouldery, cobbly, to pebbly coarse to fine sands. Non-indurated to weakly indurated, moderately stratified, poorly sorted, matrix- and clast-supported deposits with dominantly angular to subangular clasts, with some subrounded clasts. Clasts are dominantly volcanic rock, with some granitic rocks near the central stream channel of Winnemucca Valley. Surfaces are generally eroded with moderately developed pavements, littered with weakly to moderately varnished cobbles and boulders. Soils typically have A/Bt/Bca/C profiles. Argillic horizons (Bt) are reddened, commonly well structured, and up to 50 cm thick. Calcic horizons are discontinuous and variable, but locally have up to stage III CO_3 development.

Qbp Megabreccia and fanglomerate of Pyramid sequence rocks Megabreccia and fanglomerate consisting primarily of Pyramid sequence conglomerate (Tpc) and lesser basaltic andesite (Tpb); dominated by large angular blocks (up to 6 m in length) of moderately indurated matrix-supported, pebble conglomerate that was derived from nearby exposures of Tpc. The deposit includes both sheets of megabreccia and unconsolidated, poorly sorted, matrix-supported conglomerate. It probably originated as both rock avalanches and debris flows. The deposit is confined to a relatively narrow paleocanyon on the southwest flank of the Virginia Mountains, which is currently being exhumed by a modern drainage. Most of the material was probably derived from a prominent butte (elevation 1916 m) situated about 0.5 km northwest of the current northernmost extent of the deposit. A small bench on the southeast side of the butte represents a possible point source for the deposit. Catastrophic failure of the moderately to steeply dipping conglomerate beds that comprise the butte may have produced the bench.

Qfb Fanglomerate of basaltic andesite Pebbly to bouldery fans that typically form at the base of steep slopes and are dominated by clasts of basaltic andesite (Tpb). Surfaces range from smooth to irregular and commonly have active portions. In some cases, well-developed argillic horizons are present, especially near the base of the fans. Exposures are generally poor, but can locally be found in the cutbanks of washes. The rare exposures reveal light-gray to pale-brown, matrix- to locally clast-supported, poorly to locally moderately sorted, poorly stratified, conglomerate with subangular and angular clasts up to 2 m in length. Clasts of basaltic andesite (Tpb) dominate all exposures, but clasts of conglomerate (Tpc), andesite (Ta), and welded tuffs occur in some deposits. Qfb is generally nonindurated but older deposits are locally weakly indurated by calcareous cement. Matrix is typically coarse sand and composed of subangular grains of volcanic lithic fragments, feldspar, and lesser quartz. Most of this deposit probably originated as debris flows. Thickness may locally exceed 20 m.

Qf Undifferentiated Quaternary fanglomerates Small- to medium-size fans that typically form along the base of steep slopes. Bouldery, cobbly, pebbly sand deposits that are typically clast-supported and dominated by subangular and angular clasts. Clasts are derived from local sources and, thus, are almost ubiquitously Tertiary volcanic rock; however, rare clasts of Cretaceous granite or Mesozoic metasedimentary rock occur in some deposits. Surfaces range from smooth to irregular and commonly have active portions. In some cases, well-developed argillic horizons are present, especially near the base of the fans, but exposures of the deposits are not common. Thickness may locally exceed 20 m.

QTa Late Miocene to Pleistocene(?) alluvial deposits A coarse alluvial deposit consisting mostly of clasts from the Pyramid sequence underlies a series of ridges along the southwest side of the Warms Springs fault. Clasts, which are moderately rounded and up to 1 m in diameter, are mostly basaltic andesite (Tpb), with lesser porphyritic basaltic andesite (Tpp), conglomerate (Tpc), and silicic volcanic rock. Silicic rocks comprise about 10% of clasts in the southeasternmost occurrences and decrease in abundance to the northwest. Matrix of the deposit is nowhere exposed. Contacts with underlying units (QTc and QTk) suggest the deposit dips moderately southwest, away from the Warm Springs fault. The deposit is similar to conglomerate (Tpc) of the Pyramid sequence and to Quaternary fan deposits and may correlate with either. If correlative with Tpc, the "clasts" of conglomerate may actually be the matrix of the deposit. Age of the unit is uncertain but younger than QTc and QTk.

QTc Late Miocene to Pleistocene(?) conglomerate Poorly exposed conglomerate, composed dominantly of clasts of silicic volcanic rocks, and other sedimentary rocks crop out along the southwest side of the Warm Springs fault. All "exposures" consist of a lag of volcanic cobbles, which are well rounded and up to 20 cm in diameter. Matrix of the deposit is nowhere exposed. The deposit underlies QTa, which is its only age constraint, and occupies the same stratigraphic position as QTk. Thickness is as much as 15 m.

QTk Late Miocene to Pleistocene(?) sedimentary rocks Poorly exposed pebble conglomerate, sandstone, and ash crop out in the two southeasternmost ridges along the Warm Springs fault. Pebbles are exclusively Cretaceous granitic rock (Kqmd), well rounded, and up to 2 cm in diameter. Most exposures consist of a lag of granitic pebbles. However, a small quarry at the northern end of the southeasternmost ridge shows steeply southeast-dipping pebble conglomerate, sandstone, and ash. It includes moderately well- to well-sorted beds 2 to 15 cm thick. The deposit underlies QTa, which is its only age constraint, and occupies the same stratigraphic position as QTc.

Pyramid Sequence

The informally named Pyramid sequence (Bonham and Papke, 1969) consists of aphyric to finely porphyritic basaltic andesite lava (Tpb), coarsely porphyritic basaltic andesite lava (Tpp), conglomerate, breccia, sandstone, and other clastic rocks dominated by clasts of lava (Tpc), diatomite (Tpd), and dacitic (Tpmu, Tpml) to rhyolitic? (Tpmm) tuff. These rocks are complexly interbedded. Mafic lavas become more abundant in the northwest part of the map area. Coarse sedimentary rocks become more abundant southward and are particularly thick and well exposed in the north-central part of the map area east of Paiute Canyon. This pattern suggests flows were derived mostly from sources to the north, possibly near Tule Peak. However, probable cinder cones that were the source for some flows occur to the southeast in the northern part of the Moses Rock Quadrangle (Castor and others, 1999). The dacitic tuffs are restricted to the southeastern corner of the quadrangle and adjacent areas in the Sutcliffe and Moses Rock Quadrangles to the east and southeast, respectively (Castor and others, 1999). In most of this area, they overlie basalt (Tpb), conglomerate (Tpc), and diatomite (Tpd). However, additional basalt overlies the tuffs in the Moses Rock Quadrangle (Castor and others, 1999). The stratigraphic relation of the tuffs to lavas and sedimentary rocks farther north and west in the Tule Peak Quadrangle is unknown. However, a nonwelded, pumiceous tuff intercalated in conglomerate (Tpc) in the northern part of the map area may correlate with the tuffs of Mullen Pass.

The Pyramid sequence is locally folded and highly tilted (dips locally exceed 60°). Possible explanations for the folding within the Pyramid sequence include shortening within an apparent left step or restraining bend between the northwest-striking, right-lateral Pyramid Lake and Warm Springs Valley fault zones, ancient mega-landslides, or deposition and subsequent compaction and subsidence on highly irregular topography. In the first two cases, much of the Pyramid sequence appears to have been detached from the underlying section of ash-flow tuffs, megabreccia, and rhyodacite lavas and tuffs, possibly along several gentle to moderately dipping décollements.

Tpmu Upper tuff of Mullen Pass Dark-gray to black, glassy, dacitic ash-flow tuff with prominent dark-gray, glassy, flattened pumice crops out in the southeastern corner of the quadrangle. The tuff is a single cooling unit, composed of several ash flows, that grades from a moderately welded base into a thick densely welded zone. A nonwelded top may have been present but is not preserved in the Tule Peak Quadrangle. Preserved thickness is about 40 m. The pumice is up to 40 cm long and 5 cm thick and makes up 10% to as much as 50% of the whole rock. Small (≤1cm) fragments of basaltic andesite (Tpb?) are common. Phenocrysts (25-30%): plagioclase (20-25%; <1-3mm), clinopyroxene (2%, <1-2mm), orthopyroxene (<1%, ≤0.7mm), biotite (≤1%, ≤1mm), hornblende (<1%, 0.5mm), and opaques (≤1%, ≤0.5mm). Age:13.77±0.15 Ma, hornblende; C98-246; Sutcliffe Quadrangle just east of outcrops in the southeastern part of the Tule Peak Quadrangle. 13.84±0.15 Ma; plagioclase, probably from this tuff (Swisher, 1992). Also, 12.7 Ma (no ± reported), plagioclase K/Ar, (Evernden and James, 1964). Equivalent to Member 7 of the Pyramid Formation of McJannet (1957).

Tpmm Middle tuff of Mullen Pass White, pumiceous, dacitic or rhyolitic tuff, bedded tuff, tuffaceous sediment, and conglomerate separate the lower (Tpml) and upper (Tpmu) dacitic tuffs of Mullen Pass. Massive tuff contains pumice to 40 cm in diameter, is nonwelded, and mostly glassy, and may be a coarse, proximal air-fall deposit. Bedded tuff is planar to cross bedded, contains pumice up to 5 cm, and is probably reworked from massive tuff. Both types contain common lithic fragments of porphyritic silicic volcanic rocks and aphyric basalt (probably Tpb). Conglomerate consists of moderately rounded clasts of basaltic andesite (probably Tpb). Pumice phenocrysts (10%): plagioclase (5%, 2mm), hornblende (2%, 1-4mm), and biotite (2%, 1-2mm). Maximum thickness is ~40 m.

Tpml Lower tuff of Mullen Pass Dark-gray to black, poorly to densely welded, dacitic ash-flow tuff, similar to the upper tuff (Tpmu) but less abundantly porphyritic, underlies the middle tuff of Mullen Pass (Tpmm) in the southeastern corner of the quadrangle and continues into the Sutcliffe and Moses Rock Quadrangles (Castor and others, 1999). The tuff is a single cooling unit composed of several ash flows totaling about 10 m thick in the Tule Peak Quadrangle but thickens to 50 m and two cooling units directly to the east, where two densely welded zones, 3 to 4 m thick, are sandwiched between poorly welded zones 5 to 10 m thick. Most, possibly all, of the tuff is glassy. Pumice that is more sparsely porphyritic than the matrix is a prominent constituent in all parts of the tuff. The pumice is black, flattened, and up to 20 cm long in welded parts. The tuff contains as much as 10% lithic fragments composed of basaltic andesite (Tpb?) and porphyritic felsic volcanic rocks. Phenocrysts (15%): plagioclase, clinopyroxene, hornblende, and biotite. Equivalent to member 5 of the Pyramid Formation of McJannet (1957).

Tpb Basaltic andesite lavas Aphyric to finely and sparsely porphyritic basaltic andesite makes up numerous flows throughout the Pyramid sequence. Flow interiors, which make the most prominent outcrops, are typically dark gray, massive to platy and faintly flow banded. The platy foliation distinguishes aphyric from porphyritic lavas, which generally make rounded, rubbly outcrops. Basal and upper breccias are generally scoriaceous and oxidized and rarely crop out. Individual flows are 10 to 30 m thick and appear to have greater lateral continuity than do porphyritic flows. One sequence of flows just east of Paiute Canyon near the northern margin of the map area contains volcanic bombs, basaltic agglutinate, and abundant scoria, suggesting a nearby volcanic center. Phenocrysts (generally <5%): olivine (0-5%; ≤1 mm; commonly partly altered to iddingsite). Groundmass consist of pilotaxitic, subophitic to intergranular plagioclase, pyroxene, and opaque minerals. Some flows along the crest of the range are nearly flat-lying and appear to rest in angular unconformity above more steeply tilted conglomerate (Tpc), suggesting that some of the tilting and folding in this area coincided with deposition of the Pyramid sequence. Age: 15.6±2.4 Ma, whole rock, K/Ar, from sample near the base of the Pyramid sequence in Sutcliffe Quadrangle immediately to the east (Bonham and Papke, 1969). Thickness of individual units is as much as 250 m, whereas the cumulative thickness in the north-central part of the map area exceeds 350 m.

Tpp Porphyritic basaltic andesite lavas Coarsely porphyritic flows containing prominent, tabular plagioclase phenocrysts up to ~1 cm long have been found only in the central and northern parts of the quadrangle. Massive, resistant interiors make rounded, rubbly outcrops, whereas scoriaceous upper and lower breccias rarely crop out. Individual flows are mostly 10 to 30 m thick and can terminate abruptly, suggesting they locally filled paleovalleys. Phenocrysts (15-25%): plagioclase (10-20%, up to 1cm long by 0.5 to 2mm thick), olivine (5-8%, 0.1-1mm). Matrix consists of plagioclase, olivine, clinopyroxene, opaques, and variably altered, interstitial glass.

Tpd Diatomite Massive to finely laminated, white, nonresistant diatomite forms discontinuous layers mostly low in the Pyramid sequence. Diatomite layers are a few to about 20 m thick and commonly contain interbeds of fine sandstone and siltstone. The soft diatomite rarely crops out but is shown by a lag of numerous white chips. Leaf fossils are abundant in diatomite, especially in several trenches in the southeastern part of the quadrangle. Axelrod (1956) assigned the fossils a middle Miocene age. The diatomite appears to have accumulated in local closed basins, probably mostly related to paleotopography on the underlying Oligocene-Miocene volcanic rocks and blocking of drainages by lavas, but possibly also indicating some faulting shortly before or during deposition of the Pyramid sequence.

Tpci Clastic dike Similar in composition to Tpc; as much as 1 m thick.

Tpc Conglomerate and breccia Massive to moderately well stratified, matrix supported, poorly to moderately sorted, pale-brown to light-gray pebble to cobble conglomerate, breccia, and lesser sandstone. Clasts are subangular to subrounded and generally composed of basaltic andesite (Tpb and Tpp). Sparse clasts of siliceous volcanic rock occur throughout the map area but become more common in the west-central part of the quadrangle, where clasts of the tuff of Chimney Spring (Tcs) and Nine Hill Tuff (Tnh) are locally prominent. Conglomerate locally includes lenses of fine- to coarse-grained sandstone as much as 8 cm thick; sand grains are subangular to subrounded and consist mainly of volcanic lithics and feldspar. Tpc is noncalcareous and weakly to moderately indurated. Beds range from a few centimeters to a more than 1 m thick. Thicker more massive beds are generally unsorted and probably originated as debris flows. They contain mostly basaltic andesite clasts, commonly up to 1 m and rarely to 2 m in diameter. Finer deposits include well-bedded, more moderately sorted, matrix- to locally clast-supported conglomerate with clasts up to 25 cm in diameter and thin beds of pebbly, commonly ferruginous sandstone. In the north-central part of the map area to the west of Hardscrabble Creek, conglomerate in the lower part of the Pyramid sequence locally includes clast-supported beds with well rounded pebbles and cobbles of volcanic rock (basaltic andesite and welded tuff) as much as 20 cm long, as well as intercalated cross-bedded sandstone and beds of nonwelded tuff up to 30 cm thick. The finer-grained units probably originated as sheetflood and/or fluvial deposits. These lithologies suggest a fanglomerate origin for the bulk of Tpc. The composition of the fans further implies a nearby source area consisting of mafic volcanic centers and/or thick sequences of mafic lavas. The conglomerate is complexly interbedded with sequences of basaltic andesite lavas and diatomite and, in areas of poor exposure, may locally include thin basaltic andesite lavas and diatomite. The thickest and best exposed sections of conglomerate are found in the rugged terrain between Paiute Canyon on the west and the crest of the Virginia Mountains on the east. The conglomerate appears to coarsen to the northwest concomitant with an increase in basaltic andesite lavas. Just east of Paiute Canyon along the northern fringe of the map area, cobble- to boulder-size clasts become more common in the conglomerate, and volcanic bombs and agglutinate are found within Tpb, suggesting a nearby volcanic center. In the north-central and northwest parts of the map area, centimeter to kilometer-scale folds are locally well developed in the conglomerate. In addition, the conglomerate is commonly more steeply tilted than underlying Oligocene ash-flow tuffs. The relative stratigraphic position of most of the conglomerate is not known. However, a pumiceous tuff intercalated within the conglomerate in the northern part of the map area may correlate with the tuffs of Mullen Pass. Thickness of individual units is as much as 175 m, whereas the cumulative thickness in the north-central part of the map area exceeds 350 m.

Tpbi Basaltic andesite dikes A few dikes of basaltic andesite crop out in the north-central part of the map area. Phenocrysts are typically sparse (<5%) and generally consist of olivine with lesser amounts of clino- and orthopyroxene. Olivine is largely altered to iddingsite. Dikes range from 1 to 20 m in width. A thick dike cutting Tpc east of Paiute Canyon in the north-central part of the map area has well-developed columnar joints.

Ta Andesite lavas Isolated exposures of medium-gray andesite lavas are found in the west-central and north-central parts of the map area just east of Paiute Canyon and directly northwest of Gin Peak (south part of section 30, T24N, R21E), respectively. The andesite has a pilotaxitic texture and contains 25-30% phenocrysts of plagioclase (andesine), hornblende (mainly oxyhornblende), augite, ±hypersthene, and sparse biotite (in order of decreasing abundance). Accessory minerals include titanomagnetite and apatite. In some areas, hornblende is largely altered to iron oxides and chlorite. The andesite is compositionally similar and may temporally correlate with the Kate Peak volcanics (e.g., Thompson and White, 1964). Thickness is as much as 25 m.

Tai Andesite dikes Northeast- to east-striking andesite dikes are found throughout the map area. They generally have a trachytic texture and contain 5-20% phenocrysts. Phenocryst assemblages include plagioclase (andesine), biotite, lesser clinopyroxene (mainly aegirine), and sparse hornblende; augite and lesser plagioclase (andesine); and augite, hornblende, and lesser plagioclase (andesine) (all in order of decreasing abundance). Mafic constituents are partly to largely altered to chlorite. The dikes generally range from 1 to 4 m in width and are commonly elliptically shaped (i.e., thickness decreases toward dike tips). Uranium mineralization is associated with some of the dikes (Castor and others, 1996). The dikes cut units as young as the tuff of Chimney Spring (Tcs).

Rhyolite Group

The rhyolite group consists of rhyolitic to dacitic shallow intrusions and lava domes, petrographically similar and more mafic dikes, rhyodacite lava, and rhyodacite (?) tuff. The intrusions, domes, and dikes are concentrated in the southeastern part of the quadrangle and extend southward from the Needle Rock area (which is the eastern part of a large intrusion) into the Fraser Flat Quadrangle (Garside and others, 1999), which lies directly south of the Tule Peak Quadrangle. Small isolated intrusions are also found as far west as the Paiute Canyon area. Petrographically similar rhyodacite lava and ash-flow tuff crops out as far west as the west-central part of the map area. The intrusions lie within or near the northern flank of the "Perry Canyon caldera" (Castor and others, 1999; Garside and others, 1999, 2000) and are probably part of caldera-related magmatism. Slumping from the flanks of steep intrusive domes generated the megabreccia, and clasts of rhyolite are a prominent constituent of megabreccia.

Td Dacite-rhyodacite lavas Light to medium gray porphyritic rhyodacite and dacite lavas containing 35-40% phenocrysts of plagioclase (andesine to 2.5 mm), lesser oxyhornblende and biotite (to 3 mm), quartz, and sparse sanidine. Hornblende and biotite are more abundant in Td than in Trd. Accessory minerals include titanomagnetite, apatite, and zircon. These lavas crop out in the south-central part of the quadrangle. Thickness is as much as 20 m.

Trd Rhyodacite lava and welded tuff Light-gray, locally weathering to pale- brown, rhyodacite(?) lavas and welded tuff containing phenocrysts of, in order of decreasing abundance, plagioclase (oligoclase and andesine; to 2.5 mm) and lesser biotite (to 1.5 mm), hornblende (to 1 mm), and quartz (to 4 mm); rose quartz is common; typically includes accessory titanomagnetite, apatite, and zircon; also characterized by spherulites and sparse lithic fragments of andesite. The upper part locally weathers into boulder rubble and is difficult to distinguish from rhyodacite megabreccia. These lavas are thickest and most widespread in the south-central and east-central parts of the map area, suggesting a genetic relationship with the nearby rhyolite domes. Thickness is as much as 100 m.

Trt Rhyodacite ash-flow tuff and conglomerate Nonwelded to weakly welded light-grayish-white ash-flow tuffs and lesser light-gray to greenish-gray, weathering orange brown, volcaniclastic conglomerate. The tuff typically contains 25-35% phenocrysts of plagioclase (oligoclase; 12-20%, up to 2.5 mm long), quartz (3-7%, up to 3 mm long), biotite (3-4%, up to 2.5 mm long), sanidine (trace to 4%), and oxyhornblende (0-3%). Hornblende is commonly partly to largely altered to iron oxides. Accessory minerals include titanomagnetite, apatite, and zircon. White pumice fragments and lithic fragments of biotite-hornblende rhyodacite collectively constitute up to 15% of the tuff. Conglomerate is matrix supported, and contains dacite and rhyodacite pebbles within a reworked tuffaceous matrix, and locally includes petrified wood. Clasts are entirely volcanic and range up to 25 cm in diameter. This nonresistant unit typically forms slopes between the more resistant underlying megabreccia and overlying rhyodacite lavas and is locally complexly intercalated within the megabreccia. Flute casts at the base of an overlying megabreccia unit between Incandescent and Mine Canyons trend north-northeast. This unit is largely confined to the south-central part of the map area, where it thickens southward across several south-dipping faults. The nonwelded tuffs may partly correlate with the tuff of Perry Canyon (Castor and others, 1999; Garside and others, 1999, 2000) to the east and southeast, as evidenced by similar overall composition and stratigraphic positions. Thickness is as much as 120 m.

Tbd Rhyodacite-rhyolite breccia Grayish-brown to pale-brown megabreccia composed primarily of rhyolite, rhyodacite, and dacite blocks, which greatly resemble Tri, and isolated blocks of tuff (e.g., Tcs). Clasts range from several centimeters to several meters (>4 m) in diameter. Some of the rhyodacite-rhyolite, especially in the lowermost units, appears to be slightly silicified. Good exposures are rare; outcrops typically consist of bouldery rubble of rhyodacite and rhyolite. Tbd crops out in the east- and south-central parts of the map area and probably originated as rock avalanches (cf., Yarnold and Lombard, 1989) induced by slumping and catastrophic failure of the steep-sided rhyolite domes. Thickness is about 20 m.

Tbt Tuff breccia Purplish- to reddish-brown and brick red megabreccia composed primarily of blocks of welded ash-flow tuff and minor rhyolite-rhyodacite. Blocks of the tuff of Chimney Spring (Tcs) dominate the megabreccia, but clasts of the Nine Hill Tuff (Tnh) and the tuffs of Whisky Spring (Tws) can also be found. Many of the blocks appear to be slightly silicified. Tbt also includes minor volcaniclastic conglomerate that contains petrified wood. The best exposures can be found in the southwest-facing cliffs of the Painted Hills between Incandescent and Mine Canyons. This unit appears to be confined to the east- and south-central parts of the quadrangle and probably originated as rock avalanches induced by slumping and catastrophic failure of steeply dipping intruded strata around the flanks of rhyolite domes to the east and southeast. Sanidine from a clast of Tcs within the megabreccia has yielded an $^{40}Ar/^{39}Ar$ date of 24.91±0.06 Ma. Thickness is as much as 120 m.

Tdi Porphyritic dacite dikes Coarsely porphyritic dacite(?) forms several dikes in the southeastern part of the quadrangle, where they cut porphyritic rhyolite domes (Tri) or tuffs adjacent to the domes. The dikes are 5 to 20 m wide and can be traced for as much as 300 m. Their distribution and petrographic character (similar phenocryst assemblage as the rhyolite domes but with lesser quartz and lacking sanidine) indicate the dikes are more mafic variations of the rhyolite domes. Phenocrysts (10-25%; interiors of domes are generally more abundantly porphyritic): plagioclase (8-20%; 1-10 mm), biotite (1-3%; 1-3 mm), hornblende (1-2%; 1-5 mm), and quartz (<1%, 1-2 mm).

Tri, Trix Porphyritic rhyolite domes Coarsely and abundantly porphyritic, low-silica rhyolite to high-silica light-gray dacite forms numerous, partly coalescing, shallow intrusions and lava domes. Individual bodies are up to 1 km in diameter and massive to thickly flow banded. **Trix** marginal breccia is developed along the flanks of several domes and was mapped separately where particularly thick. Intrusion of the domes locally induced steep tilting of the ash-flow tuffs. Several bodies appear to be laccoliths, probably fed by dikes, that intruded most commonly at the base of the Nine Hill Tuff. One trap-door laccolith steeply tilted Nine Hill Tuff along its northern flank but cut vertically through the tuff along its southern edge. Phenocrysts (~30-40%): plagioclase (mainly oligoclase, 20-30%, 1-15 mm), biotite (2-7%, 1-5 mm), quartz (<1-5%, 2-6 mm), hornblende (1-3%, 1-4 mm), and sanidine (0-1%, 3-20 mm). Hornblende is commonly altered to iron oxides. Plagioclase phenocrysts are commonly partly to completely altered to sericite. Abundant blocks of the porphyritic rhyolite are found in the megabreccia deposits to the south and west of the domes. Age: 23.51±0.08 Ma, sanidine; 23.54±0.26 Ma, biotite; C98-79. 23.62±0.06 Ma, sanidine, (clast in megabreccia; Tbd).

Oligocene Ash-Flow Tuffs

Tiu Upper tuff of Incandescent Canyon Nonwelded to poorly welded yellowish- to pale-reddish-brown ash-flow tuff that contains 15-20% phenocrysts of sanidine (12%, up to 3 mm long), quartz (3-4%, up to 3.5 mm long), plagioclase (oligoclase, 1-3%, up to 2 mm in length), and biotite (1-2%, up to 2 mm). Sanidine is locally adularescent, and quartz is locally smoky. Biotite is typically partly altered to iron oxides. Accessory minerals include titanomagnetite and apatite. Much of the tuff has been devitrified. Fewer phenocrysts, more abundant biotite, and less quartz distinguish Tiu from Tcs. This unit is best exposed on several ridges in the Painted Hills. Incandescent Canyon is the prominent northeast trending canyon in the Painted Hills in section 6 (T23N, R21E) and section 12 (T23N, R20E). It typically forms a distinct ledge or low cliff above the white, slope forming Til and beneath the jumbled megabreccia. This unit probably correlates with the upper tuff of Chimney Spring of Garside and others (1999), which has been informally referred to as the tuff of Gary's Ridge (H.F. Bonham, oral commun., 1998). Sanidine has yielded an $^{40}Ar/^{39}Ar$ date of 24.74±0.06 Ma. Thickness is as much as 50 m.

Til Lower tuff of Incandescent Canyon White to locally light-gray or pinkish-gray nonwelded ash-flow tuff that contains 15-20% phenocrysts of sanidine (9-13%, up to 2 mm in length), quartz (~4%, up to 2.5 mm long), plagioclase (oligoclase, <1-3%, up to 3 mm in length), and biotite (<1-2%, up to 2 mm long), and rare hornblende. Accessory minerals include titanomagnetite, zircon, and apatite. Til contains up to 20% white pumice fragments. The lower part of Til locally includes the upper nonwelded part of Tcs. Minor unconformities appear to separate Til from both Tcs and Tiu. In the former case, Til appears to fill a few small, but locally steep sided paleochannels cut into Tcs. In the latter case, tuffaceous conglomerate containing clasts of andesite locally separates Til from Tiu. Fewer phenocrysts, more abundant biotite, and less quartz (and relatively sparse smoky quartz) distinguish Til from Tcs. The degree of welding and color distinguish Til from Tiu. The best exposures of this unit occur on several ridges directly northwest of Incandescent Canyon. Thickness is as much as 60 m.

Tilw Poorly welded lower tuff of Incandescent Canyon Pale-orange, weakly welded rhyolite tuff that appears to be intercalated in the upper part of Til. Phenocryst assemblage is essentially identical to that of Til, but smoky quartz is more common than in typical Til. This unit was mapped only in the west-central part of the map area ~1 km northeast of the corral in Paiute Canyon directly west of the dirt road that ascends to the crest of the Virginia Mountains. Thickness is as much as 5 m.

Tcs, Tcsl Tuff of Chimney Spring Pinkish-gray, weathering reddish brown to purplish red, densely welded, abundantly porphyritic ash-flow tuff; smoky quartz and adularescent sanidine characterize Tcs. The overall tuff grades upward from basal, poorly welded to middle, densely welded, to upper, poorly welded. Several individual ash flows, marked by abrupt changes in lithic or pumice concentrations, are recognizable in the lower part. Greater abundance of biotite and plagioclase in the lower and upper, poorly welded parts than in the densely welded part suggests compositional zoning; however, intense devitrification and vapor phase crystallization in the welded part has also destroyed most mafic minerals. The massive, densely welded part mostly contains little pumice, so eutaxitic texture is poorly developed, whereas upper and lower parts contain as much as 20% white pumice to 15 cm long. Lithic fragments, most abundant in the lower part, consist of porphyritic, silicic to intermediate volcanic rocks, and lesser quartzite and indurated shale. Thickness is about 80 m or slightly more where it occupies paleovalleys that were not completely filled by Nine Hill Tuff (Tnh). The overall tuff and densely welded part may thin slightly northwestward. **Tcsl** The lower, poorly welded part was mapped locally where particularly thick, especially in west of Paiute Canyon. Mine Canyon is the deep, north-northeast- trending canyon directly northwest of the Painted Hills. The base of the lower tuff is 8 m thick, layered, contains carbonized wood, and overlies a thin conglomerate that overlies Nine Hill Tuff. Phenocrysts (25-40%): quartz (10-20%, 1-3mm), sanidine (10-20%, 1-3mm), plagioclase (0-3%, <1-2mm), biotite (<1-2%, ≤1mm), and hornblende (<1%, ≤0.7mm). Age: 24.91±0.06 Ma, sanidine, 24.91±0.06 Ma, sanidine, clast in megabreccia.

Ttu Undifferentiated nonwelded tuff Light gray to pale greenish or pinkish gray nonwelded to very weakly welded tuff containing phenocrysts of sanidine, plagioclase, biotite, and ±quartz. Ttu may locally include the basal nonwelded zone of Tcs and Tnhl, especially in poorly exposed areas. Ttu includes both pumice-rich and pumice-poor nonwelded tuffs. Pumice fragments range up to 20 cm in length. Between Incandescent and Mine Canyons, Ttu beneath Tca has fewer phenocrysts and more abundant biotite than overlying Tca. Ttu beneath Tnh generally contains more biotite and less quartz than Ttu between Tcs and Tnh. Ttu is generally a nonresistant, poorly exposed slope-forming unit but locally weathers into craggy moderately well-exposed outcrops. Lithic fragments are common in some tuffs and are dominated by volcanic rocks (andesite and dacite) but include Mesozoic metasedimentary rock (argillite and phyllite). Some tuffs contain petrified wood, especially between Tcs and Tnh. Ttu locally includes thin (< 1 m thick) intercalated conglomerate layers that contain subrounded to subangular clasts of chert, quartzite, and argillite. Thickness of individual units is as much as 140 m.

Tnh, Tnhl Nine Hill Tuff Purplish- to reddish-brown, moderately to densely welded and white to pale brown nonwelded, commonly highly pumiceous, sparsely porphyritic ash-flow tuff. Although a single cooling unit, the tuff is highly variable in thickness and welding because it filled paleovalleys cut into underlying "Whisky" tuffs. The tuff passes upward from a poorly to nonwelded base to densely welded to a moderately welded top. Maximum thickness is about 90 m in paleovalleys; increased thickness results primarily from an increase in the lower nonwelded part. The densely welded part is mostly about 20 m thick and thickens only slightly into valleys. The tuff thins and locally pinches out over ridges, which may be partly a result of erosion. Densely welded vitrophyre is present in thinner parts, and lower nonwelded tuff is mostly glassy. Pumice fragments that are more sparsely porphyritic than the bulk tuff are prominent. In densely welded parts, they commonly make flattened lenses up to 40 cm long. In nonwelded parts, they are ellipsoidal and up to 20 cm in length. Glass lumps with similar phenocryst assemblage as the tuff are common in the lower, nonwelded part. The tuff also contains sparse lithic fragments of porphyritic to aphyric silicic volcanic rocks up to a few centimeters in diameter. The Nine Hill Tuff is widely distributed through western Nevada and the Sierra Nevada and may correlate with unit D of the Bates Mountain Tuff in central Nevada (Bingler, 1978; Deino, 1985; 1989). **Tnhl** The lower, poorly to nonwelded part was mapped locally, particularly where it thickens into paleovalleys, for example, west of Pradere Spring and along the south-central edge of the quadrangle. Pale-brown, poorly welded tuff grades downward into medium-gray, glassy poorly welded to nonwelded vitrophyre. This unit is probably more widespread than shown but was commonly lumped with Ttu in areas of poor exposure. Phenocrysts (5-15%): sanidine (3-8%; 1-2mm), anorthoclase (2-6%; 1-2mm), plagioclase (<1-2%; 1-2mm), quartz (0-1%, 1-2mm), biotite (0-1%, 1mm), and clinopyroxene (0-1%, ≤1mm). Presence of three feldspars in thin section is distinctive. Age: 25.09±0.06 Ma, sanidine, MC-10.

Tca Andesite-clast conglomerate Poorly sorted, poorly stratified, matrix-supported pale-brown to pale-greenish-brown pebble-cobble conglomerate intercalated within Ttu. Tca is poorly indurated and noncalcareous. Clasts are generally subangular and typically consist of andesite, basaltic andesite, and lesser dacite, including conspicuous porphyritic andesite with large phenocrysts of pyroxene and hornblende. Clasts of intermediate composition range from a few centimeters to 4 m in diameter. Mafic constituents within the clasts are commonly altered to chlorite. The matrix consists of subrounded to subangular coarse-grained sand mainly of volcanic lithics and lesser feldspar and quartz. Clasts of Nine Hill Tuff (both Tnh and Tnhl) up to 1 m in diameter are common directly beneath Tcs in the uppermost units of Tca, which also contain clasts of andesite and siltstone. Clasts are subrounded to rounded in some of these units. In upper Mine Canyon, a 4-m-thick conglomerate crops out directly beneath Tcs and is dominated by pebbles and cobbles of Tnhl; interbedded sandstone in this unit is primarily reworked tuff and may include a black paleosol. Tca was primarily deposited in paleochannels cut into Ttu. Tnh and Tcs were also deposited in some of the same paleochannels. The poorly stratified, matrix-supported nature of the thicker deposits suggest a debris-flow origin. The dominance and size of andesite clasts suggests both a nearby source terrain of stratovolcanoes and high topographic relief. Thickness varies considerably from 2- to 3-m sequences directly beneath Tcs to as much as 60 m in a large paleochannel between Incandescent and Mine Canyons.

Tuffs of Whisky Spring

Tws_5 Upper welded tuff of Whisky Spring Reddish-brown to pale-orange-brown, sparsely porphyritic welded tuff that contains <10 to 15% phenocrysts of sanidine, plagioclase, biotite, and possibly sparse quartz. Tws_5 appears to fill small paleochannels just beneath the stratigraphic level of Tnh and may grade laterally into light gray to white nonwelded tuff. This unit is not laterally extensive; outcrops are typically less than 200 m in length. Thickness is as much as 7 m.

Tws_4, Tws_4l Welded tuff of Whisky Spring White to pale-brown, pinkish- or purplish-gray, and reddish-brown, weakly to moderately welded ash-flow tuff that contains 15 to 30% phenocrysts of plagioclase (calcic oligoclase and sodic andesine, 7-15%, up to 3 mm long), sanidine (4-12%, up to 3 mm long), biotite (1-7%, up to 2.5 mm long), and rare hornblende, which is commonly altered to iron oxides. Plagioclase is generally 3 to 5% more abundant than sanidine, but sanidine and plagioclase can occur in subequal amounts. Accessory minerals include titanomagnetite, apatite, and zircon. Conspicuous pumice fragments are not common. Tws_4 locally consists of multiple cooling units. Thickest exposures occur in the lower Mine Canyon area and directly south of Hardscrabble Creek. In both areas, Tws_4 probably accumulated in paleovalleys. A conspicuous basal vitrophyre characterizes Tws_4 directly west of Mine Canyon. Exposures in the northeast and north-central (e.g., just south of Hardscrabble Creek) parts of the map are characterized by a lower, relatively crystal-rich zone (30% phenocrysts) that grades upward to a more sparsely porphyritic unit (~15% phenocrysts). In the lower Mine Canyon area, a reddish-brown cooling unit containing ~20% phenocrysts was locally mapped separately as Tws_4l. Tws_4 grades into poorly exposed nonwelded tuff in both the south-central (lower Mine Canyon area) and northeast parts of the map area and, thus, is probably more widespread than shown. More abundant plagioclase relative to sanidine, greater overall abundance of biotite, and common pale brown to grayish color distinguishes Tws_4 from the other welded tuffs of Whisky Spring. This unit may partly correlate with the tuff of Coyote Spring of Garside and others (1999). Age: $^{40}Ar/^{39}Ar$ on sanidine, 29.02±0.10 Ma. Thickness is as much as 100 m.

Tws_3 Welded tuff of Whisky Spring Pinkish-gray to more commonly reddish-brown, moderately welded tuff that contains 10 to 15% phenocrysts of sanidine (6-8%, up to 4 mm long), plagioclase (oligoclase, 1-4%, up to 3 mm long), and biotite (<1-2%). Accessory minerals include titanomagnetite, apatite, and zircon. Flattened white pumice fragments are locally conspicuous and range up to 15 cm in length. Tws_3 also contains small amounts of lithic fragments of porphyritic andesite and metasedimentary rock (greenish-gray siltstone). In the lower Mine Canyon area, Tws_3 includes an upper grayish- to pinkish-white, poorly welded to nonwelded zone, within which biotite is slightly more abundant. Lithic fragments are common in this upper zone; they range up to 10 cm in length and consist of argillite (or siltstone), intermediate to felsic lava, and welded tuff. Pumice fragments are also common in the upper nonwelded zone and are as much as 18 cm in length. The basal nonwelded zone is typically less than 3 m thick and was locally lumped with Twsn. Although not particularly thick, Tws_3 crops out over much of the map area. The ubiquitous reddish color, higher degree of welding, fewer phenocrysts, relative abundance of sanidine versus plagioclase, and less biotite distinguish Tws_3 from Tws_4. Age: $^{40}Ar/^{39}Ar$ on sanidine, 29.73±0.07 Ma. Thickness is as much as 15 m.

Tws_2 Biotite-rich welded tuff of Whisky Spring Biotite- and crystal-rich, pinkish-gray, weathering reddish to purplish brown, welded tuff that contains ~35% phenocrysts of plagioclase (calcic oligoclase and sodic andesine, ~22%, up to 2.5 mm long), biotite (7-8%, up to 1.5 mm long), and sanidine (~5%, up to ~1 mm long); typically becomes more crystal-rich up-section. Accessory minerals include titanomagnetite (~1%) and apatite. This tuff is not particularly thick or widespread. It pinches out northward in the lower Mine Canyon area. The abundance of plagioclase and biotite distinguish Tws_2 from most other "Whisky" tuffs. Compared to Tws_4, plagioclase is much more abundant than sanidine and biotite is also more common. Thickness is as much as 10 m.

Tws_1 Lower biotite-poor welded tuff of Whisky Spring Light-purplish- or pinkish-gray, weathering reddish-brown, moderately to densely welded tuff that contains 5 to 10% phenocrysts of sanidine (4-9%, up to 3 mm long), plagioclase (mainly oligoclase, trace to 4%, up to 2 mm long), quartz (trace to 1%), and biotite (trace to <1%, up to 2 mm long). The abundance of sanidine is at least twice that of plagioclase and is commonly 8 to 9 times that of plagioclase. Biotite is commonly partly or largely altered to iron oxides. Accessory minerals include titanomagnetite, hematite, and apatite. The sparse biotite, the presence of quartz, and the relatively sparse plagioclase distinguish Tws_1 from the other "Whisky" tuffs. Tws_1 outcrops commonly contain abundant ellipsoidal cavities produced by weathered out pumice fragments. Tws_1 is thick and widespread, cropping out throughout the map area where the appropriate part of the section is exposed. Thickness is as much as 85 m.

Twsn Nonwelded tuffs of Whisky Spring White, light- to medium-gray, to pale-brown, nonwelded tuff that typically contains sanidine, plagioclase, and biotite phenocrysts. Biotite phenocrysts are generally more abundant than in Ttu. Pumice and lithic fragments are locally abundant; locally contains rounded pebbles and/or lithic fragments of metasedimentary rock. A light-gray, glassy sanidine-nonwelded tuff directly beneath Tws_1 was included within Twsn but may represent the lower nonwelded zone of Tws_1. Twsn, at least locally, includes the poorly exposed upper and lower nonwelded zones of the Tws_1 through Tws_5 tuffs. Age of Twsn directly beneath Tws_3: $^{40}Ar/^{39}Ar$ on sanidine, 29.73±0.08 Ma. Thickness of individual units is as much as 80 m.

Cretaceous Basement

Kqmd Quartz monzodiorite Coarse-grained, light-gray quartz monzodiorite and granodiorite consisting of, in decreasing order of abundance, plagioclase, potassium feldspar, quartz, hornblende, biotite, and accessory titanomagnetite, sphene, and zircon. Kqmd is commonly weakly foliated. Foliation is generally defined by the preferred orientation of hornblende. Sparse enclaves of diorite range up to 20 cm in length. The granite generally weathers into large angular blocks or rounded boulders surrounded by grus. In some areas, 10-25 cm of grus mantles bedrock exposures. The grus is locally oxidized to a reddish-brown color. This unit is identical to the Kqmd in the Fraser Flat Quadrangle (Garside and others, 1999).

Contact Long dashes where approximately located, short dashes between different tuffs within same map unit, or approximate bedding within massive conglomerate; queried where uncertain; dotted where concealed.

Fault Showing dip of fault and trend of striae on fault surface (arrow); ball on downthrown side; double arrows show sense of strike-slip offset; dashed where approximately located, queried where uncertain, dotted where concealed.

Syncline axial trace Showing plunge, dashed where approximately located; dotted where concealed.

Landslide headwall scarp Hachures point into landslide.

Landslide toe Hachures point into landslide.

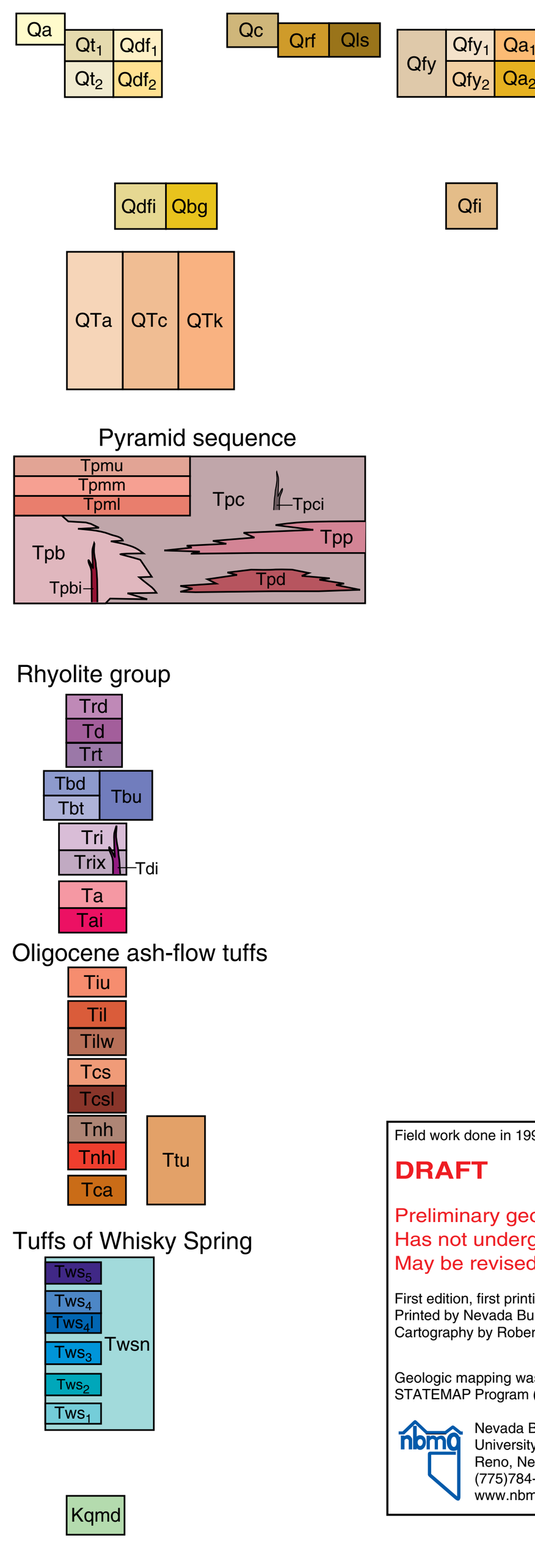
Strike and dip of beds
20 Inclined — Vertical — Horizontal

Strike and dip of compaction foliation in ash-flow tuff
30 Inclined — Vertical

Strike and dip of flow bands in lava or intrusion
70 Inclined — Vertical
Continuous curving flowbands

Sample location for $^{40}Ar/^{39}Ar$ date or chemical analysis
H00-14

Stipple pattern indicates exposed caliche within eroded Qfy_2.



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